International Journal of Offshore and Polar Engineering (ISSN 1053-5381)

Vol. 19, No. 2, June 2009, pp. 143–150

Finite Difference Analysis of Dilatory Dissipation on Piezocone Test in Overconsolidated Cohesive Soil

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For a commonly used piezocone with a shoulder filter element, dilatory dissipation behavior, which shows an initial temporary increase in pore pressure, has been observed in overconsolidated clay soils. In this study, dilatory dissipation with a wide range of OCR was investigated in order to provide its theoretical and substantial grounds. Finite difference analyses on the dissipation after cone penetration were performed with the initial distribution of the excess pore pressure derived by the empirical modification of a solution proposed by the cavity expansion theory and critical state concept. It was found that in lightly overconsolidated soils, the upward propagation of the excess pore pressure from the lower cone face to the shoulder filter could lead to dilatory dissipation. Meanwhile, in heavily overconsolidated soils, the horizontal propagation of excess pore pressure in the inward direction to the cone, in addition to the upward propagation, increase the significance and possibility of dilatory dissipation. In addition, a parametric study showed that increases of OCR and the ratio of hydrostatic pressure to effective vertical stress (u_0/σ'_{v0}), as well as the decrease of the rigidity index (I_r), resulted in more probable and significant dilatory dissipation.

INTRODUCTION

The piezocone penetration test (CPTu) is a widely utilized technology for the in-situ investigation of the ground that operates by measuring the cone and sleeve resistances and pore pressure developed by cone penetration. In addition, a dissipation test, carried out by measuring the pore pressure change with time after halting cone penetration, provides the determination of the coefficient of consolidation, which controls the time-dependent deformation of cohesive soils.

For a commonly used piezocone with a shoulder filter element immediately behind the cone tip, a dissipation test performed in normally consolidated cohesive soils shows monotonically decreasing pore pressure (Fig. 1a). However, in overconsolidated cohesive soils, a dissipation test records dilatory pore pressure behavior showing an initial temporary increase in pore pressure followed by a decrease to hydrostatic pressure (Lunne et al., 1986; Sully et al., 1988; Chen and Mayne, 1994; Burns and Mayne, 1998). Fig. 1b gives an example of the dilatory dissipation. Fig. 1 was obtained from the dissipation test results at Yangsan, located

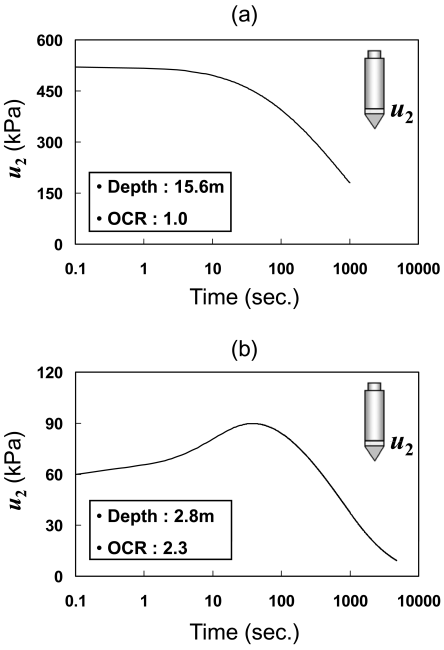

Fig. 1 Pore pressure dissipation responses at Yangsan: (a) general dissipation for normally consolidated soil of lower layer, (b) dilatory dissipation for overconsolidated soil of upper layer

Received September 12, 2008; revised manuscript received by the editors February 8, 2009. The original version (prior to the final revised manuscript) was presented at the 18th International Offshore and Polar Engineering Conference (ISOPE-2008), Vancouver, July 6–11, 2008.
KEY WORDS: Dilatory dissipation, piezocone test, overconsolidated cohesive soil, coefficient of consolidation, finite difference analysis.